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The Use of Aircraft in the Application of Chemicals to Agricultural  
Crops in the Soviet Union

I. Introduction

A. General

The Soviet Government currently is devoting considerable attention to the use of chemicals as a means of increasing agricultural production. The amount of mineral fertilizer allocated to Soviet agriculture is supposed to increase from 10.6 million metric tons in 1958 to 31 million metric tons by the end of the Seven Year Plan in 1965 (Selskoye Khozyaystvo, 15 March 1959, p. 3). Although currently the amount of herbicides and insecticides used in Soviet agriculture is relatively small, considerable attention is also being given to the combatting of agricultural pests and weeds by the use of chemicals. Information is not available concerning the amounts of insecticides and herbicides produced at present or concerning the planned production of these chemicals in 1965.

B. Volume of Work Done with Aircraft

The use of aircraft in the application of chemicals to agricultural crops in the Soviet Union has been increasing rapidly, having more than doubled during the past five years. The following data on the volume of aviation-chemical work show the increasing importance of aircraft as a means of applying chemicals to agricultural crops in the USSR:

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<u>Year</u>	<u>Increase over 1940<sup>1/</sup></u> <u>(percent)</u>	<u>Area covered<sup>2/</sup></u> <u>(1,000 hectares)</u>
1940	100	1,000
1950	350	3,500
1951	400	4,000
1952	500	5,000
1953	600	6,000 <sup>2/</sup>
1954	700	7,000 <sup>2/</sup>
1956		11,000 <sup>3/</sup>
1958		16,200 <sup>4/</sup>
1960 (plan)		26,500 <sup>3/</sup>
1965 (plan)		32,500 <sup>4/</sup>

The Soviets plan to double the area of agricultural crops on which chemicals are applied from airplanes between 1958 and 1965. Although the Soviets have generally fallen far short of past planned goals in agriculture and related fields, the use of aircraft in the application of chemicals to agricultural crops in the Soviet Union is expected to continue to increase rapidly in the years ahead. The generally larger size of fields and farming units in the Soviet Union than in the United States and other countries tend to make aircraft a relatively more economical method of applying chemicals to agricultural crops than in the other countries.

#### C. Uses of Aircraft in Soviet Agriculture

The different types of work in the agricultural field being done by aircraft in the Soviet Union are numerous. According to the Soviets, even in 1954, aviation-chemical work, at least in Ukrainian agriculture already was ceasing to have a seasonal character.<sup>5/</sup> Also, they state that in Uzbekistan "air-chemical work is now carried out the year round, whereas until 1954 it

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was of a seasonal nature".<sup>6/</sup> Among the more important operations in which aircraft are used in applying chemicals to agricultural crops are the application of mineral fertilizers to fall sown (winter) grains, primarily winter wheat, as well as to a number of other crops such as cotton, and sugar beets; the application of herbicides to crops such as small grains and flax; the application of insecticides to a number of different crops and to forests; and the application of defoliants to cotton. Other types of work carried out by aircraft in the general field of agriculture include the spraying of vineyards and orchards, the seeding of forest and desert areas, patrol flights protecting forests areas from fire, extermination of wolf packs in the cattle raising areas of Siberia, and hunting fur-bearing animals in the Far East.

D. Published Information on Movement of Agricultural Aircraft

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were told that the aircraft used in Soviet agriculture were centrally controlled and dispatched. Also, it is stated that "in contrast to the prewar period, - - - - a schedule of operations was set up which followed the course of agricultural work throughout the various geographical areas."<sup>7/</sup> Little information is published, however, on the actual movement of aircraft equipped for applying chemicals between the different agricultural areas of the Soviet Union. An article on pages 6-7 of the no. 3, 1958 issue of the journal Civilian Aviation contained the statement that "Besides the

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high-quality work conducted in the Ukraine, the same flight commanded by Babich dispatches airplanes for aerial treatment of cotton fields in Uzbekistan and Kirgiziya." A broadcast from Kiev stated that "a group of AN-2 planes of the Ukrainian Civil Aviation Fleet equipped with fertilizer spreading devices left for Uzbekistan on May 29 to help the cotton growers. They will be working in Andizhan, Namangan, and (Kashan?) Oblasts. It is planned to send such groups also to Krasnodar Krai and Azerbaydshan." 8/ Another broadcast, this one from Leningrad, stated that "Ten AN-2 aircraft with equipment for combating agricultural pests will be sent by the Northern Administration of Civil Aviation to the Virgin Lands of Kazakhstan. ---- Preparations for the flight from Leningrad to Kazakhstan (Kustanai and Pavlodar Oblasts mentioned) began on April 6 at Leningrad Airport." 9/ Finally, a Pavlodar broadcast on April 24, 1959 stated that "Every year the Northern Directorate of the Civil Aviation Fleet sends airplanes to the Virgin Lands to help with weed and pest killings.----- the planes will bring as May Day gifts books and musical instruments for field mechanizers." 10/

#### E. Limitations of the Study

The research work carried out on this project has resulted in a number of limitations of the study becoming apparent. Very little information on the dates at which the various crops reach the different phenological stages in the principal agricultural areas of the USSR was found in Soviet

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literature. The dates at which the various crops are normally planted in the different regions could not be found in the basic literature on Soviet Agriculture. Thus, the data upon which this study is based represent one of the more pronounced limitations of the study.

Phenological data on winter rye, winter and spring wheat, and spring barley were obtained from the following books by M.Y. Muttonson of the American Institute of Crop Ecology: Rye - Climate Relationships and the Use of Phenology in Ascertaining the Thermal and Photo-Thermal Requirements of Rye, Washington, D.C., 1958; Wheat-Climate Relationships and the Use of Phenology in Ascertaining the Thermal and Photo-Thermal Requirements of Wheat, Washington, D.C., 1955; and Barley - Climate Relationships and the Use of Phenology in Ascertaining the Thermal and Photo-Thermal Requirements of Barley, Washington, D.C., 1957. These studies are based upon data which were obtained from agricultural experiment stations in the Soviet Union and pertain to a period some 30-40 years ago. The question immediately arises, does the experiment station data accurately reflect the phenological stages for crops in the area or could the differences in agricultural practices and in the seed varieties used on the experiment stations as opposed to those in general use in the agriculture of the area have caused a significant variation in the phenological stages of the crops? Also, have technological changes and the development of new seed varieties during the past several decades caused a significant change in the duration of the various phenological

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stages of the different crops. Answers to these questions could not be found in recent literature published by the Soviets.

Information on the approximate seeding and harvesting dates for oats was obtained from an ORR report published in June 1958. Additional information on this report can be obtained, if needed, from ORR/W/AG. The table used from this report as well as the appropriate pages from the Huttonson studies are contained in Appendix C. Reference to maps from NIS 26, Section 61, "Agriculture, Fisheries, and Forestry," April 1958, Figures 61-10, 11, 14, 15, 17, 22, 62, and 63, showing acreage distribution of various crops in the USSR, may be useful to readers of this report.

The lack of phenological information also pertained to the technical crops considered in this study. In order to estimate the ranges of probable planting dates for these crops, it was necessary to study spring planting progress reports in the Soviet press for the past 3-4 years.

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Despite a lack of basic information the conclusions reached in this study will serve as a useful guide in determining when aircraft are most likely to be used in applying chemicals to agricultural crops in the Soviet Union.

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## II. Methodology

### A. General

Phenological data on several of the small grains (wheat, rye, and barley) were obtained from the above mentioned studies by M.Y. Muttonson. Muttonson's studies are based on data from North America and thermally analogous areas in the Soviet Union and other European countries. Average and extreme dates for the sowing, heading, and ripening of winter rye, and winter and spring wheat, and spring barley in the principal agricultural areas of the USSR were determined from these data. This was done by inspecting the data given for individual experiment stations within each agricultural area in the USSR. In some instances, where insufficient data were available, it was necessary to consider data from stations outside but immediately adjacent to the agricultural area in question.

Phenological data for oats were not available as such and had to be derived from planting and harvesting information in the above mentioned ORR report. Since all the small grains have similar phenologies, that for oats was calculated by applying general phenological information, provided by a US crop specialist at Beltsville, to the planting and harvesting dates.

In addition to general information concerning the phenology of the

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various crops, specialists at Beltsville also provided information on the stages of development during which the various types of agricultural chemicals can or would most likely be applied to these crops under normal conditions.

As indicated above, phenological data were unavailable from Soviet publications for the technical crops (fiber flax, sugar beets, sunflowers, and cotton) considered in this study. In order to determine approximate dates for the different stages of development for these crops, it was necessary to (1) scrutinize Soviet press reports on spring seeding progress for the past 3-4 years in order to determine the range of dates during which each of the technical crops is normally planted; (2) apply the general phenological information supplied by the Beltsville specialists to these planting periods. In this manner, approximate dates for the various phenological stages pertinent to the application of agricultural chemicals were obtained.

B. Agricultural chemicals

To achieve maximum effectiveness and to avoid possible deleterious effects on crop growth and yields, agricultural chemicals should be applied only when the plants are in certain stages of development. The times at which these chemicals are best applied vary not only according to whether a crop is of the narrow-leaf (small grains and fiber flax) or broad-leaf (sugar beets, sunflowers, and cotton) type but also according to type of chemical (herbicides, insecticides, mineral fertilizer, or defoliant) applied.

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1. Herbicides

Herbicides achieve their greatest utility in controlling weeds in crops which are members of the grass family such as grains and fiber flax. The grain crops are not particularly susceptible to herbicidal damage except during the critical tillering, blooming, and heading stages of development.\*

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\* The application of herbicides to corn has not been considered in this study. Phenological data are not available for corn in the USSR, and it is believed that herbicides would not generally be applied to corn by airplanes.

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To be most effective in controlling weeds and yet not cause yields to be adversely affected, herbicides should be applied to small grains during the jointing stage. However, no direct information is available on the dates of the jointing stages. Heading and ripening dates for the small grains in the different regions of the USSR were used as points of reference in calculating the ranges of dates during which herbicidal treatment would most likely take place. The heading and ripening were taken from Muttonson and are given in Appendix C. It was assumed that jointing starts 7 weeks prior to ripening and lasts 3 weeks, for all small grains and in all areas.

The approximate phenological dates given in Appendix B were used in calculating the range of possible dates during which herbicidal spraying would be carried out on the small grains. It was assumed that the beginning of spraying coincides with the onset of jointing and continues until one week before heading.

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The similarity of the phenologies of the different small grains sown in the spring and of the winter grains after the tillering stage resulted in the use of the same criteria for all these crops in determining the ranges of dates during which herbicides would most likely be applied. Differences in phenologies between the individual grains are generally less than those which occur between varieties of the same grain. Varietal difference, according to the Beltsville specialists, can cause up to two weeks difference either way in the phenological development of a grain.

Fiber flax differs from the small grains somewhat in that it is usually treated with herbicides at a much earlier stage of development. As opposed to the small grains, fiber flax is most effectively sprayed with herbicides when it is 2-6 inches tall. It attains this height 3-4 weeks after emergence, or about 4-6 weeks after planting. This is the criteria employed in setting the range of dates when herbicides would most likely be applied to fiber flax.

Sugar beets, sunflowers, and cotton, all broad-leaf crops, are generally not treated with herbicides during the growing season. These crops are highly susceptible to damage by herbicides. If these crops are to be sown in a particularly weedy area and chemical weed control is desired, the common practice is to apply herbicides prior to the time of emergence. (Sugar beets, sunflowers, and cotton emerge 1-2 weeks after planting). The only available

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information contrary to this indicates that cotton in the USSR is sometimes sprayed with an herbicide in conjunction with cultivation, implying the chemical would be applied from the ground. No information whatever is available to suggest that aircraft are used during the growing season to apply herbicides to sugar beets, sunflowers, or cotton. Thus, it has been assumed that aircraft are not used to apply herbicides to these crops in the Soviet Union.

## 2. Insecticides

Insecticides are applied to a relatively wide range of crops in the Soviet Union. They generally can be applied at almost any stage of crop development, depending upon time of insect infestation, without harmful effects. Aircraft are becoming more widely used in applying insecticides as well as the other agricultural chemicals. According to the Soviets, the use of aircraft as a means of application results in more efficient utilization of available agricultural chemicals which are in relatively short supply in the USSR.

With respect to the small grains, the ranges of dates when insecticides could be applied, found in Appendix A, were based on the premise that if it were necessary to spray a crop, it could be done anytime between emergence (about 1-2 weeks after sowing) and about a week or so prior to ripening. Spraying later than this might possibly result in a toxic residue being left on the harvested grain.

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Fiber flax, according to a specialist at Beltsville, rarely suffers a severe insect problem. If spraying is required, however, it could be carried out during the same stages of development as for the small grains.

In the case of sugar beets, which are frequently and severely infested with beet weevils in the Ukraine, insecticides can probably be effectively applied from aircraft anytime between emergence and the time the leaves are sufficiently large to cover the soil surface, approximately 3-3 1/2 months after planting. If an infestation were to occur subsequent to this stage of development, eradication would probably be most effective if insecticides could be applied to both the top and bottom leaf surfaces. Thus, it is assumed that application of insecticides after the plants are 3-3 1/2 months old would be made by ground equipment.

Sunflowers are most susceptible to insect attack when the plant is about two months old. Flower head formation is beginning about that time, and it has been assumed that insecticides would be applied then.

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[redacted] stated that if the Soviet cotton crop becomes infested, the most likely time to apply insecticides is from early July to early September. This is the criteria that has been used in setting the ranges of dates found in Appendix A.

### 3. Mineral Fertilizers

In the past, the technical crops have been the principal

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claimants of the limited amounts of mineral fertilizers available in the USSR. However, fertilization of winter grain crops has been increasing in recent years. Spring crops other than the technical crops also receive applications of mineral fertilizer. Recent increases in the supply of mineral fertilizer is resulting in a wider variety of crops being fertilized. Most of the mineral fertilizers applied to spring crops, including spring-sown grain, technical crops, potatoes, and vegetables, are applied at the time of soil preparation or planting. Subsequent side-dressings of mineral fertilizers, in general, are applied by a surface means to row crops. Aircraft are used in applying mineral fertilizers mainly to winter grain and certain technical crops.

Applications of mineral fertilizers from aircraft to winter grain, primarily winter wheat,\* are made both in the fall and spring. It is

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\* It is believed that most of the mineral fertilizers applied to winter grains is applied to winter wheat because the returns are greater.

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believed, however, that most of this work is performed in the spring.

With respect to determining the times when mineral fertilizers would most likely be applied from aircraft to winter wheat, the following criteria were used. In order for winter wheat to benefit from mineral fertilizers applied during the fall months, application should be made well in advance of the end of the growing season. It has been assumed,

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therefore, that this type of agricultural chemical would be applied by aircraft over a four week period centered around a date about six weeks before the snow cover normally becomes established in each of the principal winter wheat regions of the USSR. Also, the assumption has been made that mineral fertilizers applied to winter wheat in the spring would most likely be put on over a four week period centered around a date about two weeks after the snow cover disappears.

The dates when the snow cover normally becomes established and disappears are important in determining the most likely times when mineral fertilizers would be applied to winter grain. Average dates for these natural phenomena for the principal winter wheat regions (the Ukraine, North Caucasus, and Central Black Soil Zone) were estimated from data in NIS 26, Section 23, "Weather and Climate of the USSR."

Little evidence was found that aircraft are used in applying mineral fertilizers to spring sown crops in the Soviet Union. In 1952 and 1953 aircraft reportedly were used in applying mineral fertilizers to relatively small acreages of cotton and sugar beets. 11/ No evidence was found that aircraft are used in applying mineral fertilizers to spring sown grains or fiber flax. However, if mineral deficiencies become evident during the growing season in these crops, aircraft would probably be the best means for applying fertilizers. For the purpose of this study, it has been assumed that, if aircraft are used in applying mineral fertilizers to spring sown

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crops, their use for this purpose would roughly correspond to the periods when insecticides would most likely be applied, as shown in Table 1.

4. Defoliants

The use of aircraft in applying defoliants to cotton in the USSR has been increasing rapidly in recent years. The Soviets reported that in 1951 about 20% of the cotton in Uzbekistan, where about two-thirds of Soviet cotton is produced, was defoliated by aerial spraying. 12/ Currently, the Soviets state that ground equipment should be used for spraying defoliants on cotton only in those areas inaccessible to aircraft by reason of trees, power lines, etc.13/ Thus, it may be assumed that a large part of the cotton in the Soviet Union is defoliated by means of aerial spraying.

Defoliants are sprayed on the cotton crop at the time the bolls begin to open. In the Soviet Union, this normally occurs from about mid-September until about mid-October. This has been verified by

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who visited the main USSR cotton growing areas in 1958 and witnessed the beginning of aerial application of defoliants in mid-September.



### III. Seasonal and Geographic Pattern of Aerial Spraying and Dusting.

A summary of the periods during which various types of agricultural chemicals are most likely to be applied to selected crops in the principal agricultural areas of the Soviet Union, as given in Appendix A, shows that this type of work can be carried out over extended periods. The application of chemicals to agricultural crops is confined to the growing season. Thus, little, if any, of this work is performed during the period from about November 1 to March 1. Also, this summary shows that in some regions, namely the Ukraine, North Caucasus, Volga, Urals, and Northern Kazakhstan, a period covering on an average the first half of September would be relatively free from work in the application of chemicals to agricultural crops.

This summary also reveals that the periods during which the various types of agricultural chemicals could be applied to crops in the Soviet Union are roughly as follows: mineral fertilizers would be applied to winter wheat in the spring from about mid-March to mid-May with most of the work being done in April; insecticides could be applied during a six month period from early March until early September; herbicides could be applied from about mid-April until mid-August; defoliants would most likely be applied to the cotton between about mid-September and mid-October; and the first application of mineral fertilizers would be applied to winter wheat in the fall, between the early part of September and the latter half of October.

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Although these agricultural chemicals can be applied to the various crops over rather extended periods, there are some factors which are believed to impose limitations on the periods during which aircraft would most likely be used extensively in applying the chemicals. First of all, the supply of agricultural chemicals in the Soviet Union is limited so that in general only a part of the total acreage devoted to a crop can be treated. For example, only about one percent of the grain acreage in 1957 was treated with herbicides.<sup>1b/</sup> Secondly, the largest part of a given crop in a particular area would reach the appropriate stage of development for applying chemicals over a shorter range of time than indicated by the extreme ranges in dates as given in Appendix A. Only a relatively small part of the crop is believed to reach the appropriate stage for treatment toward either end of the extreme ranges in dates when chemicals can be applied. Thus, the middle third of the extreme ranges is felt to be the period when most of the work in applying agricultural chemicals would be carried out.

It has, therefore, been assumed that the extensive use of aircraft in applying agricultural chemicals in general is limited to the middle third of the extreme ranges in dates when chemicals can be applied to crops in a particular area. These shorter periods during which aircraft are most likely to be used extensively in applying herbicides and insecticides as well as mineral fertilizers to crops in the principal agricultural areas of the Soviet Union are presented in Table 1.

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Table 1. Periods During Which Aircraft are Most Likely to be Used Extensively in Applying Chemicals to Crops in the Principal Agricultural Areas of the Soviet Union<sup>a/</sup>

	Herbicides		Insecticides		Mineral Fertilizers			
					Fall		Spring	
Belorussia	5 Jun	15 Jul	5 Jun	1 Aug				
Central Non-Black Soil Zone	25 May	30 Jun	25 May	15 Jul				
Central Black Soil Zone	25 May	25 Jun	25 May	15 Jul	1 Sep	1 Oct	1 Apr	1 May
Ukraine and Moldavia	15 May	30 Jun	12 May	10 Jul	15 Sep	15 Oct	1 Apr	1 May
North Caucasus	20 May	15 Jun	10 May	25 Jun	1 Oct	1 Nov	15 Mar	15 Apr
Volga	1 Jun	5 Jul	1 Jun	25 Jul				
Urals	5 Jun	5 Jul	1 Jun	20 Jul				
West Siberia	10 Jun	10 Jul	5 Jun	25 Jul				
Kazakhstan (Northern Part)	15 Jun	15 Jul	1 Jun	20 Jul				
					Defoliants			
Central Asia <sup>b/</sup>	5 May	5 Jun	5 May	1 Sep	10 Sep		15 Oct	

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Sources:

- a/ Further information on the procedures used in this research project is contained in the Methodology section of this report.
- b/ These periods for applying chemicals are believed applicable to the southern part of Kazakhstan as well as to the Uzbek, Kirgiz, Tadzhik, and Turkmen Republics.

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For convenience in discussing the seasonal and geographic pattern of aerial spraying and dusting the ten agricultural areas under consideration have been combined into four groups.\*

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\*It should be noted that the Transcaucasus has not been included among the agricultural regions considered in this study. Even though it is adjacent to several of the regions considered it was not included because, in relation to Soviet Central Asia, the Transcaucasus is of minor agricultural importance except for such crops as tea and citrus fruits. Inasmuch as the periods during which aircraft might be used in applying chemicals to crops in the Transcaucasus would roughly coincide with the most intensive requirement in Central Asia, it is believed that there would be little likelihood of agricultural aircraft being transferred between these two regions.

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Belorussia, the Central Non-Black Soil Zone, the Volga Region, and the Urals comprise the first group. The extensive use of aircraft in applying herbicides and insecticides to crops in these areas would be largely confined to a period extending from about 1 June to the second half of July. Aircraft reportedly were used to apply herbicides to fiber flax in the Central Non-Black Soil Zone during the 1958 hay-making season.<sup>12/</sup> Normally haying takes place in this area around the latter half of June. As indicated in Table 1, herbicides would most likely be applied from aircraft between 25 May and 30 June in the Central Non-Black Soil Zone.

The second group is made up of the Ukraine, the Central Black Soil Zone, and the North Caucasus. Because these regions are the principal winter wheat

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growing areas of the USSR, it is believed that the extensive use of aircraft in applying mineral fertilizers to winter grains is largely confined to these areas. Aerial fertilization in the spring is likely to be most extensive from about mid-March through April and in the fall during September and October. However, it has been reported that aircraft have been used for this purpose in the southern Ukraine as early as February and in the fall as late as November and December.<sup>16/</sup> Also, in the March 1958 issue of Grashdanskaya Aviatsiya (Civilian Aviation) pages 6-7, it was reported that aerial fertilization work had already started in Kiev and Cherkassy Oblasts.

In the North Caucasus, fertilization of winter crops on the Gigant state farm started on 10 March in 1947.<sup>17/</sup> Also, by 1 April 1959, almost 70,000 hectares of crops, primarily winter wheat, (of a total of 215,000 hectares planned to be fertilized during the year) had been fertilized from the air by the Stavropol Detachment of Agricultural Aviation.<sup>18/</sup>

In the Ukraine, the Central Black Soil Zone, and the North Caucasus aerial spraying of insecticides and herbicides is believed largely confined to the period extending from about mid-May to mid-July. Thus, it is believed that the extensive use of aircraft in the spring application of mineral fertilizers and in the application of herbicides and insecticides in these regions would be completed by about mid-July and that many of the aircraft used during these periods of peak activity could be dispatched to other areas.

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The third area for discussion includes West Siberia and the Northern part of Kazakhstan. Aerial treatment of crops in this area probably is confined largely to the spraying of insecticides and herbicides. Extensive use of aircraft for this work probably would be confined largely to a period extending from about June 1 until the latter part of July. Experimental aerial spraying of herbicides on (spring) wheat was reportedly conducted on two state farms in Kustanaisky and Kerebalytsky Raions of Kustanai Oblast during the second half of June in 1958.<sup>19/</sup> Also, a radio broadcast from Alma Ata on 9 April 1959 stated that both airplanes and tractors were to be used to apply insecticides during the spring field work campaign in combatting grain stem borers in the main virgin land regions of Kazakhstan.<sup>20/</sup> As indicated earlier in the Published Information on Movement of Agricultural Aircraft section of this report, aircraft equipped for applying agricultural chemicals were sent from Leningrad to Northern Kazakhstan during the latter part of April.

The fourth area to be discussed is Soviet Central Asia, including the Uzbek, Kirgiz, Tadzhik, and Turkmen Republics and the southern part of Kazakhstan. The agricultural economy of this area is centered around cotton growing and it is in the treatment of this crop that most of avio-chemical work is performed. However, there are other crops in the area on which herbicides and insecticides are normally required. The use of aircraft in the application of chemicals to the crops other than cotton is believed to be of relatively

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less importance and confined largely to May and June.

Aircraft are used extensively to apply insecticides to the cotton fields

from about mid-July through August. According to [REDACTED]

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[REDACTED] insects appear to be well controlled in Soviet cotton fields.

He was told that some cotton fields in Azerbaydhan had received as many as

10 applications of DDT between mid-July and 1 September. However, on 10 June 1959

it was reported from Tashkent that AN-2 planes and pilots sent by the Ukrainian

administration of the Civil Air Fleet had immediately begun spraying the cotton

fields after arriving in Namangan Oblast.<sup>21</sup> Probably this early transfer

of aircraft from the Ukraine to Soviet Central Asia can be attributed to the

early spring in the Soviet Union in 1959.

As indicated in the Methodology section of this report, aircraft are not

used in applying herbicides to cotton. The period from about mid-September

to mid-October is one of intense aerial activity when the cotton fields are

being treated with defoliants.

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Sources:

- 1/ "Civilian Aviation in Agriculture", Moscow, 1954, p. 6.
- 2/ *Grazhdanskaya Aviatsiya* (Civilian Aviation), No. 11, November 1958, p. 5.
- 3/ Air Intelligence Information Report, IR-1643-57, 6 Aug 57, p. 2.
- 4/ Air Intelligence Information Report No. 1255976, 31 July 1959, p. 2.
- 5/ Civilian Aviation, op. cit., p. 43.
- 6/ *Grazhdanskaya Aviatsiya* (Civilian Aviation), No. 4, 1956, p. 32.
- 7/ *Zashchita Rasteniy Ot Vreditel'ov i Bolesney* (The Protection of Plants Against Pest and Diseases), No. 6, Moscow, Nov/Dec., p. 39.
- 8/ FBID 59, W3243, OUG.
- 9/ FBIS 59, L3876, OUG.
- 10/ FBIS 59, 14406, OUG.
- 11/ "Civilian Aviation in Agriculture," op. cit., pp. 28-30.
- 12/ Ibid., p. 68.
- 13/ *Khlopkovodstvo* (Cotton Growing), No. 9, 1959, p. 3.
- 14/ *Zashchita Rasteniy ot Vreditel'ei i Bolesney* (Protection of Plants from Pests and Diseases), No. 5, Sept. - Oct., 1959, p. 18.
- 15/ *Nauka i Zhizn* (Science and Life), No. 3, 1959, p. 30.
- 16/ "Civilian Aviation in Agriculture," op. cit., p. 43.
- 17/ Ibid., p. 51.
- 18/ *Sel'skoye Khozyaystvo*, 5 April 1959, p. 4.
- 19/ *Zemledeliye*, no. 5, 1959, pp. 36-39.
- 20/ FBID 59 L 3970, 23 April 1959, OUG.
- 21/ CIA, FBI Summary No. 2280, 19 Aug 1959, pp. 2-3, OUG.

Appendix A. Periods During which Various Types of Agricultural Chemicals May be Applied to Selected  
Crops in the Principal Agricultural Areas of the Soviet Union.<sup>5/</sup>

Crop	<u>Herbicides</u>		<u>Insecticides</u>		<u>Mineral Fertilizer</u>			
					Fall		Spring	
<u>Belorussia</u>								
Winter Rye	25 Apr	15 Jun	20 Apr	10 Aug	15 Sep	15 Oct	1 Apr	1 May
Oats	20 Jun	25 Aug	15 Apr	25 Sep				
Fiber Flax	25 May	20 Jul	15 May	15 Aug				
<u>Central Non-black Soil Zone</u>								
Winter Rye	20 Apr	10 Jun	5 Apr	5 Aug	1 Sep	1 Oct	15 Apr	15 May
Spring Barley	5 Jun	10 Jul	10 May	10 Aug				
Oats	25 Jun	1 Aug	15 Apr	1 Sep				
Fiber Flax	25 May	20 Jul	15 May	15 Aug				
<u>Central Black Soil Zone</u>								
Winter Rye	25 Apr	30 May	20 Apr	10 Aug	1 Sep	1 Oct	1 Apr	1 May
Winter Wheat	10 May	20 Jun	25 Apr	25 Jul	1 Sep	1 Oct	1 Apr	1 May
Spring Wheat	25 May	20 Jun	10 Apr	15 Aug				
Spring Barley	5 May	1 Jul	5 Apr	10 Aug				

(continued)

Appendix A. Periods During which Various Types of Agricultural Chemicals May be Applied to Selected  
Crops in the Principal Agricultural Areas of the Soviet Union.<sup>2/</sup> (continued)

Crop	<u>Herbicides</u>		<u>Insecticides</u>		<u>Mineral Fertilizer</u>			
					Fall		Spring	
<u>Central Black Soil Zone</u>								
Oats	25 Jun	1 Aug	15 Apr	1 Sep				
Sugar Beets			15 Apr	1 Sep				
Sunflowers			1 Jun	15 Aug				
<u>Ukraine</u>								
Winter Rye	10 Apr	30 May	25 Mar	25 Jul	15 Sep	15 Oct	1 Apr	1 May
Winter Wheat	25 Apr	20 Jun	1 Apr	1 Aug	15 Sep	15 Oct	1 Apr	1 May
Spring Barley	5 May	15 Jun	20 Mar	10 Aug				
Oats	20 May	1 Jul	20 Mar	1 Aug				
Fiber Flax	25 May	20 Jul	15 May	15 Aug				
Sugar Beets			15 Apr	1 Sep				
Sunflowers			1 Jun	15 Aug				

(continued)

Appendix A. Periods During which Various Types of Agricultural Chemicals May be Applied to Selected  
Crops in the Principal Agricultural Areas of the Soviet Union.<sup>2/</sup> (continued)

Crop	<u>Herbicides</u>		<u>Insecticides</u>		<u>Mineral Fertilizer</u>			
					Fall		Spring	
<u>North Caucasus</u>								
Winter Wheat	30 Apr	10 Jun	20 Apr	1 Aug	1 Oct	1 Nov	15 Mar	15 Apr
Spring Wheat	15 May	15 Jun	5 Apr	25 Jul				
Spring Barley	25 May	5 Jul	1 Apr	1 Aug				
Oats	20 May	20 Jun	25 Mar	20 Jul				
Sunflowers			1 Jun	15 Aug				
<u>Volga</u>								
Winter Rye	30 Apr	5 Jun	10 Apr	20 Jul	15 Sep	15 Oct	1 Apr	1 May
Winter Wheat	5 May	15 Jun	5 Apr	15 Jul	15 Sep	15 Oct	1 Apr	1 May
Spring Wheat	10 May	10 Jul	15 Apr	1 Sep				
Spring Barley	30 May	20 Jun	10 Apr	20 Jul				
Oats	15 Jun	10 Aug	15 Apr	10 Sep				
Sunflowers			1 Jun	15 Aug				

(continued)

Appendix A. Periods During which Various Types of Agricultural Chemicals May be Applied to Selected  
Crops in the Principal Agricultural Areas of the Soviet Union.<sup>2/</sup> (continued)

Crop	<u>Herbicides</u>		<u>Insecticides</u>		<u>Mineral Fertilizer</u>			
					Fall		Spring	
<u>Urals</u>								
Winter Rye	5 May	20 Jun	10 Apr	1 Aug	15 Sep	15 Oct	15 Apr	15 May
Spring Wheat	25 May	5 Jul	15 Apr	5 Sep				
Oats	25 Jun	5 Aug	15 Apr	5 Sep				
Fiber Flax	25 May	20 Jul	15 May	15 Aug				
Sunflowers			1 Jun	15 Aug				
<u>West Siberia</u>								
Winter Rye	15 May	20 Jun	1 May	1 Aug	15 Aug	15 Sep	1 May	1 Jun
Spring Wheat	15 Jun	25 Jul	5 May	10 Sep				
Spring Barley	25 May	10 Jul	15 May	15 Aug				
Oats	25 Jun	5 Aug	15 Apr	5 Sep				
Fiber Flax	25 May	20 Jul	15 May	15 Aug				

(continued)

Appendix A. Periods During which Various Types of Agricultural Chemicals May be Applied to Selected  
Crops in the Principal Agricultural Areas of the Soviet Union.<sup>a/</sup> (continued)

Crop	<u>Herbicides</u>		<u>Insecticides</u>		<u>Mineral Fertilizer</u>			
					Fall		Spring	
<u>Kazakhstan</u>								
Winter Rye	15 May	5 Jul	10 Apr	1 Aug	15 Sep	15 Oct	15 Apr	15 May
Spring Wheat	25 May	10 Jul	25 Apr	26 Aug				
Spring Barley	30 May	20 Jun	10 Apr	15 Aug				
Oats	1 Jul	(10 Aug)	15 Apr	(1 Sep)				
Sunflowers			1 Jun	15 Aug				
<u>Soviet Central Asia<sup>b/</sup></u>								
Winter Wheat	5 Apr	25 May	5 Mar	1 Jul	1 Oct	1 Nov	1 Apr	1 May
Spring Wheat	30 Apr	5 Jun	25 Feb	5 Jul				
Oats	5 Jun	(5 Jul)	5 Apr	(15 Aug)				
Cotton	10 Sep <sup>c/</sup>	15 Oct <sup>e/</sup>	1 Jul	1 Sep				

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Appendix B. Acreage in 1956 and Available Phenological Dates (Approximate) for Selected Crops in the  
Principal Agricultural Regions of the Soviet Union<sup>2/</sup> (continued)

Crop	1956 Acreage		Date Sown			Date Harvested			Date Ripe		
	(1,000 ha.)	Percent of USSR Total	Average	Extremes		Average	Extremes		Average	Extremes	
<u>Ukraine</u>											
Winter Rye	2,231	12.1				5 Jan	26 May	26 Jun	27 Jul	5 Jul	9 Aug
Spring Wheat	6,517	13.3	5 May	10 Apr 20 May		27 Jan	14 Jun	12 Jul	2 Aug	13 Jul	10 Sep
Oats	1,749	11.6	n/a	10 Apr 10 Jun		n/a	n/a	n/a	n/a	15 Aug	10 Sep
Fiber Flax	91	4.9									
Sunflowers	271	6.0	n/a	25 Mar 1 Jun							
Total 1956 Sown Area	17,191	8.8									
<u>West Siberia</u>											
Winter Rye	716	3.9				17 Jan	6 Jun	26 Jun	26 Jul	21 Jul	9 Aug
Spring Wheat	10,613	21.6	14 May	29 Apr 10 Jun		16 Jul	6 Jul	30 Jul	22 Aug	9 Aug	1 Oct g/
Spring Barley	432	3.8	20 May	10 May 30 May		3 Jul	13 Jun	19 Jul	6 Aug	22 Jul	22 Aug
Oats	2,869	19.0	n/a	10 Apr 10 Jun		n/a	n/a	n/a	n/a	15 Aug	10 Sep
Fiber Flax	105	5.5	n/a	25 Apr 15 Jun							
Total 1956 Sown Area	20,700	10.6									

(Continued)

S-E-C-R-E-T

Footnotes to Appendix B.

- 1/ Average data for 1976 were obtained from various pages in Volumes I and II of the Soviet statistical handbook, *Posvaynye Flotshchadi SSSR* (Main Area of the USSR), Moscow, 1977. The data upon which the phenological data for the various grains are based will comprise Appendix C to this report and will be forwarded (type remaining 5 lines of footnote as they appear in the original version).
- 2/ 1975 data.
- 3/ Data for the station at Shadrinsk, SSSR, accounts for the 1 October date. Data for other stations suggest that very little spring wheat will ripen after September 15.
- 4/ Includes the Republics of Uzbek, Kirgiz, Tadzhik, and Turkmen.
- 5/ Phenological data available from Ashkhabad, Turkmen SSR, only.

S-E-C-R-E-T



Appendix B. Acreage in 1956 and Available Phenological Dates (Approximate) for Selected Crops in the  
Principal Agricultural Regions of the Soviet Union 2/ (continued)

Crop	1956 Acreage (1,000 ha.)	Percent of USSR Total	Date Sown			Date Harvested			Date Ripened		
			Average	Extremes		Average	Extremes		Average	Extremes	
<u>European Russia</u>											
Winter Rye	486	2.6							20 Jul	3 Jul	9 Aug
Spring Wheat	17,234	35.0	8 May	18 Apr	27 May	4 Jul	17 Jun	18 Jul	15 Aug	14 Jul	2 Sep
Spring Barley	1,127	10.0	9 May	3 Apr	1 Jun	23 Jun	19 Jun	20 Jun	1 Aug	21 Jul	23 Aug
Oats	700	5.2	22	16 Apr	10 Jun					20 Aug	22
Sunflowers	300	6.7	22	25 Mar	1 Jun						
Total 1956 Sown Area	27,083	14.3									
<u>Soviet Central Asia <sup>3/</sup></u>											
Winter Wheat	528	4.8				17 May	26 Apr	1 Jun	20 Jun	31 May	6 Jul
Spring Wheat	633	1.3	14 Mar	20 Feb	22 Mar	22	22	22	4 Jul	18 Jun	11 Jul
Spring Barley <sup>4/</sup>	267	2.4	1 Apr	22	22	29 May	22	22	20 Jun	22	22
Oats	59	0.4	22	1 Apr	20 May	22	22	22	22	25 Jul	22
Cotton	1,732	53.9	22	1 Apr	1 Jun	22	22	22	22	22	22
Total 1956 Sown Area	3,414	2.9									

#-E-C-B-E-T

Footnotes to Appendix 2.

- a/ Average data for 1975 were obtained from various pages in Volume I and II of the Soviet statistical Yearbook, Praznyye Ploshchadi SSSR (Open Area of the USSR), Moscow, 1977. The data upon which the phenological dates for the various grains are based will comprise Appendix C to this report and will be forwarded (type remaining 5 lines of footnote as they appear in the original version).
- b/ 1975 data.
- c/ Data for the station at Samarkand, USSR, accounts for the 1 October date. Data for other stations suggest that very little spring wheat will ripen after September 15.
- d/ Includes the Republics of Uzbek, Kirgiz, Tadzhik, and Turkmen.
- e/ Phenological data available from Samarkand, Turkmen SSR, only.

#-E-C-B-E-T

S-E-C-R-E-T

Footnotes to Appendix A.

- a/ The periods for applying herbicides and insecticides to the various crops were derived by relating information concerning the best or most effective time (stage of plant development) of application obtain from various crop specialists at the U.S. Agricultural Experiment Station at Beltsville to the dates at which the crops in question reach the different phenological stages as contained in Appendix B. Further details on the procedure used in establishing the periods for applying herbicides and insecticides to the various crops, as well as that used in estimating the periods when mineral fertilizers would be applied by aircraft, are contained in the methodology section to this report.
- b/ Includes the Republics of Uzbekistan, Kirgiz, Tadzhik, and Turkmen. Due to proximity and the similarity of cropping patterns, the probable dates for applying chemicals in Soviet Central Asia would also apply to southern Kazakhstan.
- c/ Period during which defoliants are applied to cotton.

Note

Dates in parenthesis are estimates based upon approximate duration of the periods in other regions. Ending dates for the harvesting season were not available for oats in the regions concerned.

S-E-C-R-E-T

Appendix B. Acreage in 1956 and Available Phenological Dates (Approximate) for Selected Crops in the  
Principal Agricultural Regions of the Soviet Union <sup>a/</sup>

Crop	1956 Acreage (1,000 ha.)	Percent of USSR Total	Date Sown		Date Harvested			Date Ripe		
			Average	Extremes	Average	Extremes	Average	Extremes		
<u>Belarusia</u>										
Winter Rye	1,469	8.0			2 Jun	14 May	21 Jun	25 Jul	12 Jul	15 Aug
Oats	574	3.8	n a	10 Apr 30 May	n a	n a	n a	n a	10 Aug	30 Sep
Fiber Flax	340	17.7	n a	25 Apr 15 Jun	n a	n a	n a			
Total 1956 Sown Area	5,470	2.8								
<u>Central Non-black Soil Zone</u>										
Winter Rye	4,306	23.7			29 May	11 May	15 Jun	24 Jul	29 Jun	14 Aug
Spring Barley	868	2.3	16 May	2 May 29 May	8 Jul	27 Jun	18 Jul	6 Aug	21 Jul	18 Aug
Oats	2,980	19.4	n a	10 Apr 20 May				n a	15 Aug	5 Sep
Fiber Flax	776	40.4	n a	25 Apr 15 Jun						
Total 1956 sown area	17,812	9.1								

(Continued)

Appendix B. Acreage in 1956 and Available Phenological Dates (Approximate) for Selected Crops in the  
Principal Agricultural Regions of the Soviet Union<sup>2/</sup> (continued)

Crop	1956 Acreage (1,000 ha.)	Percent of USSR Total	Date Sown		Date Harvested		Date Ripe	
			Average	Extremes	Average	Extremes	Average	Extremes
<u>Central Black Soil Zone</u>								
Winter Rye	3,015	16.4			27 May	14 May 5 Jun	22 Jul	11 Jul 17 Aug
Winter Wheat	978 b/	5.3			15 Jun	2 Jun 30 Jun	24 Jul	14 Jul 1 Aug
Spring Wheat	2,129	4.3	24 Apr	2 Apr 11 May	20 Jun	15 Jun 27 Jun	31 Jul	18 Jul 22 Aug
Spring Barley	806	7.2	10 Apr	27 Mar 23 May	19 Jun	27 May 6 Jul	25 Jul	7 Jul 15 Aug
Oats	1,313	8.7	n n	10 Apr 20 May			n n	15 Aug 5 Sep
Sugar Beets	405	20.2	n n	1 Apr 15 May				
Sunflowers	606	15.2	n n	25 Mar 1 Jun				
Total 1956 Sown Area	19,795	8.1						

(Continued)

Appendix B. Acreage in 1956 and Available Phenological Dates (Approximate) for Selected Crops in the  
Principal Agricultural Regions of the Soviet Union <sup>2/</sup> (continued)

Crop	1956 Acreage (1,000 ha.)	Percent of USSR Total	Date Sown		Date Harvested		Date Ripe	
			Average	Extremes	Average	Extremes	Average	Extremes
<u>Cereals</u>								
Winter Rye	2,060	11.2			22 May	1 May 5 Jun	10 Jul	18 Jun 1 Aug
Winter Wheat	8,445 b/	46.2			5 Jun	17 May 26 Jun	13 Jul	21 Jun 8 Aug
Spring Barley	4,218	37.6	12 Apr	13 Mar 23 May	13 Jun	27 May 22 Jun	17 Jul	1 Jul 15 Aug
Oats	1,556	10.3	n/a	15 Mar 1 May			n/a	10 Jul 5 Aug
Fiber Flax	213	11.1	n/a	25 Apr 15 Jun				
Sugar Beets	1,273	63.4	n/a	1 Apr 15 May				
Sunflowers	1,323	26.7	n/a	25 Mar 1 Jun				
Total 1956 Sown Area	32,586	16.7						

(Continued)

Appendix B. Acreage in 1956 and Available Phenological Dates (Approximate) for Selected Crops in the  
Principal Agricultural Regions of the Soviet Union <sup>2/</sup> (Continued)

Crop	1956 Acreage		Date Sown			Date Harvested		Date Ripe			
	(1,000 ha.)	Percent of USSR Total	Average	Extremes		Average	Extremes		Average	Extremes	
<u>North Caucasus</u>											
Winter Wheat	4,956 b/	27.1				5 Jun	19 May	16 Jun	12 Jul	19 Jun	6 Aug
Spring Wheat	1,027	2.1	10 Apr	20 Mar	30 Apr	14 Jun	9 Jun	24 Jun	20 Jul	7 Jul	2 Aug
Spring Barley	1,495	13.3	10 Apr	25 Mar	10 May	n a	n a	n a	23 Jul	12 Jul	10 Aug
Oats	255	1.7	n a	20 Mar	15 May	n a	n a	n a	n a	10 Jul	29 Jul
Sunflowers	1,074	23.8	n a	25 Mar	1 Jun						
Total 1956 Sown Area	15,699	8.1									

(Continued)

Appendix B: Acreage in 1956 and Available Phenological Dates (Approximate) for Selected Crops in the  
Principal Agricultural Regions of the Soviet Union<sup>2</sup> (continued)

Crop	1956 Acreage (1,000 ha.)	Percent of USSR Total	Date Down			Date Harrowed			Date Sown		
			Average	Extremes		Average	Extremes		Average	Extremes	
<u>Wheat</u>											
Winter Rye	2,344	12.7				1 Jan	19 May	11 Jun	15 Jul	2 Jul	27 Jul
Winter Wheat	360 1/2	2.0				8 Jan	28 May	21 Jun	11 Jul	29 Jun	24 Jul
Spring Wheat	5,646	11.5	20 Apr	8 Apr	24 May	24 Jun	30 May	15 Jul	1 Aug	29 Jun	9 Sep
Spring Barley	1,046	9.3	23 Apr	3 Apr	3 May	22 Jun	19 Jun	26 Jun	22 Jul	21 Jul	25 Jul
Oats	643	4.3	22 Apr	10 Apr	20 May				22 Jul	5 Aug	15 Sep
Sunflowers	345	12.2	22 Apr	25 Mar	1 Jun						
Total 1956 Down Area	16,222	8.3									

(Continued)



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